Desinging and implementing Microservices

1. Design patterns

Reviewing Behavioral Patterns

- Behavioral patterns focus on algorithms and the distribution of responsibility between classes.

Pattern	Primary Function
Strategy	Encapsulates a family of algorithms for interchangeable use
Command	Encapsulates requests in objects for execution by another object
Iterator	Traverses any collection in a loosely coupled way
Observer	Provides notification of events without polling

Reviewing Creational Patterns

- Creational patterns hide the details of object creation.

Pattern	Primary Function
Factory Method	Creates objects of a class or its subclasses through a method call
Abstract Factory	Creates a family of objects through a single interface
Singleton	Restricts a class to one globally accessible instance

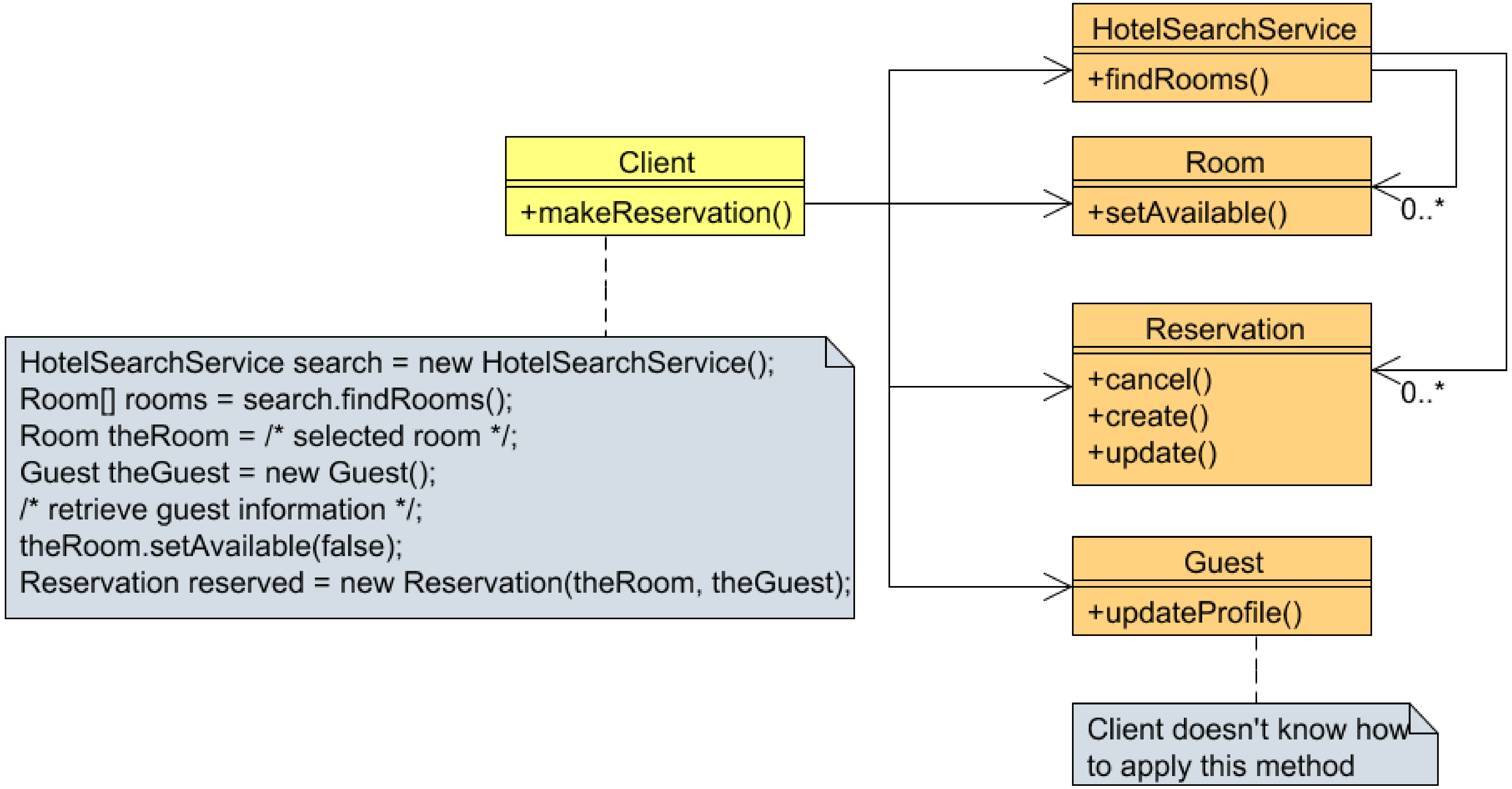
Reviewing Structural Patterns

- Structural patterns define ways to compose classes that add or modify functionality.

Pattern	Primary Function
Facade	Provides a simplified interface to a subsystem
Proxy	Provides an intermediate object that controls access to another object
Adapter	Enables a caller to use an object that has an incompatible interface
Composite	Composes objects into part-whole tree structures
Decorator	Attaches new functionality to an object dynamically

Applying the Facade Pattern: Example Problem

- Client is coupled to many classes in the reservation subsystem.



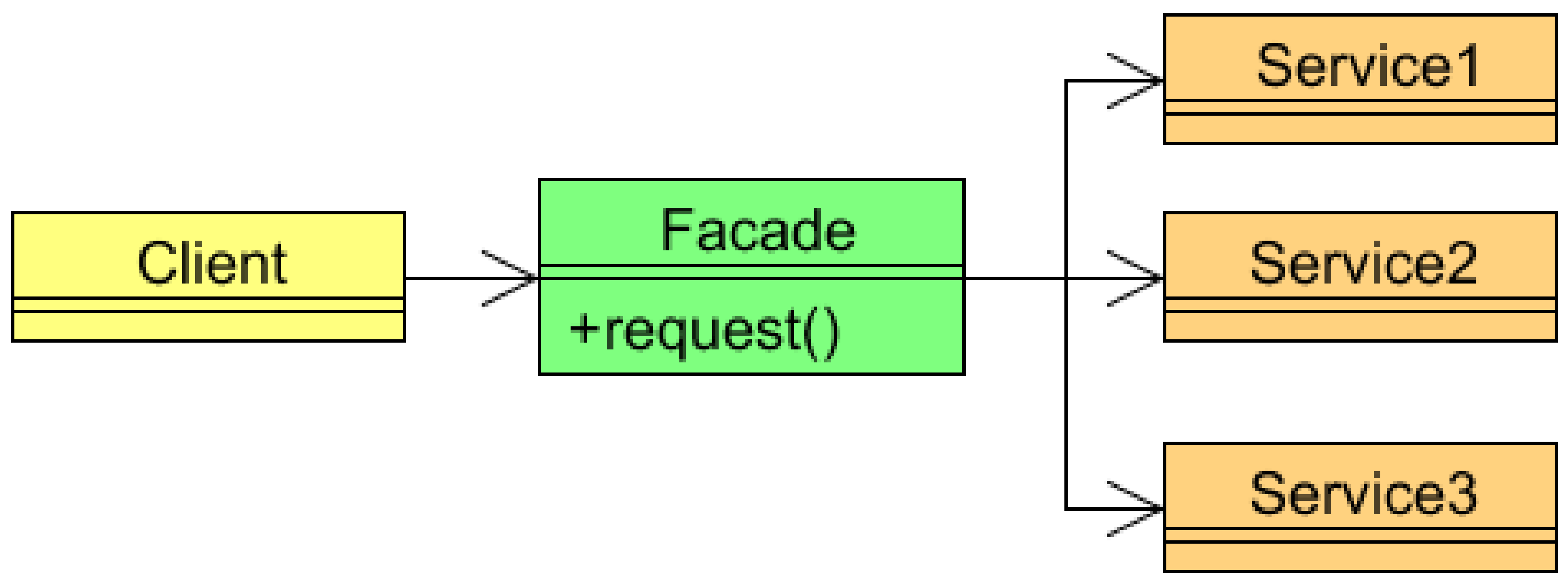
Applying the Facade Pattern: Problem Forces

- When a client directly links to many classes:
  - It is vulnerable to changes in any of those classes
  - It must know each one's interface
  - It must devise an order for calling operations and delegating parameters to them
- In a distributed environment, many fine-grained client calls can also increase network overhead.

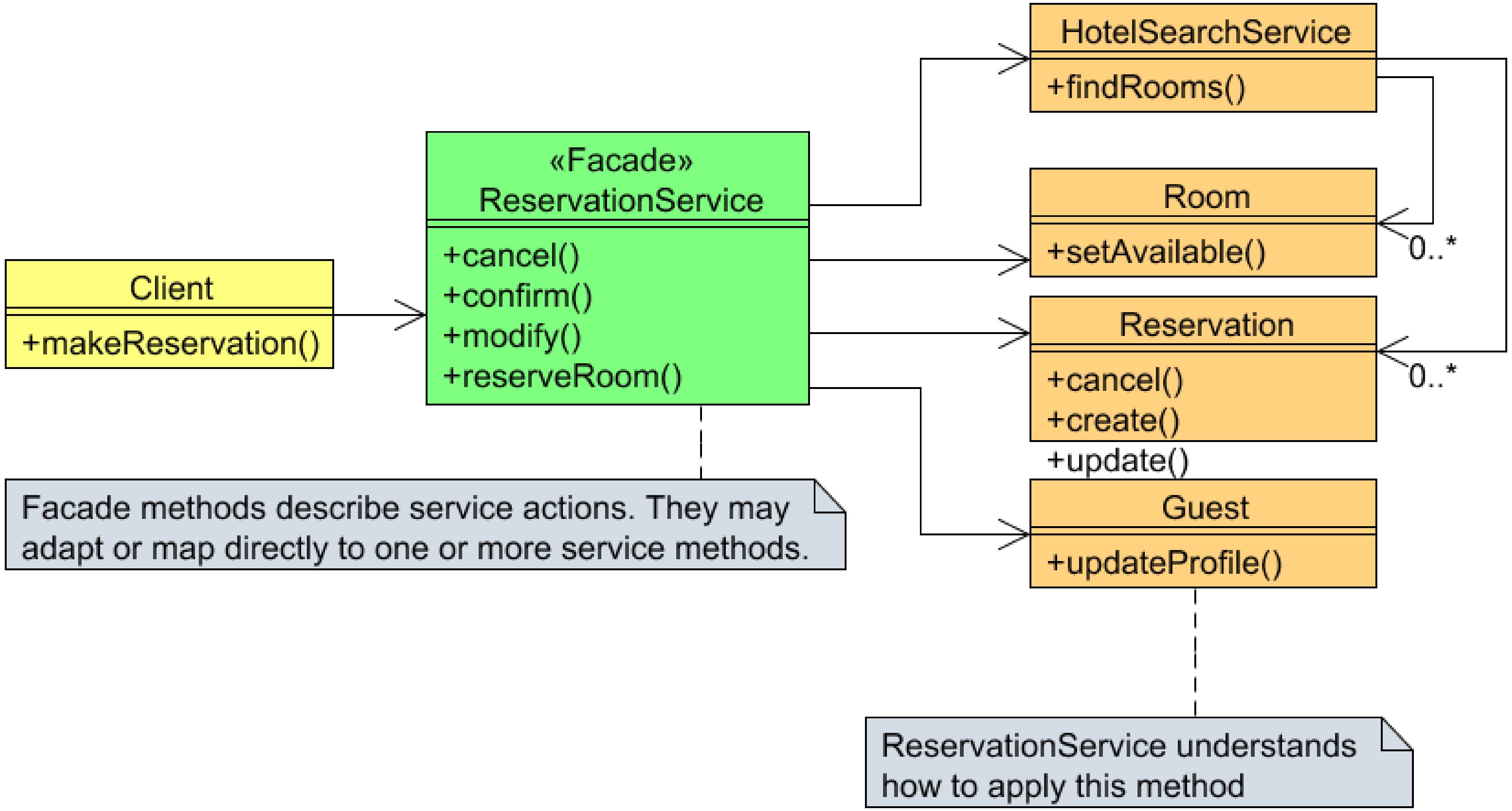
Applying the Facade Pattern: Solution

- Provide a `Facade` class that has a simple, high-level interface to a subsystem.
  - Clients use a `Facade` object instead of communicating with each subsystem object individually.
  - The `Facade` contains the logic required for sequencing, managing state, and communicating with each subsystem object.
  - The `Client` may also be allowed to communicate directly with other subsystem classes for additional functionality.

Applying the Facade Pattern: Structure



Applying the Facade Pattern: Example Solution



Applying the Facade Pattern: Consequences

Advantages:

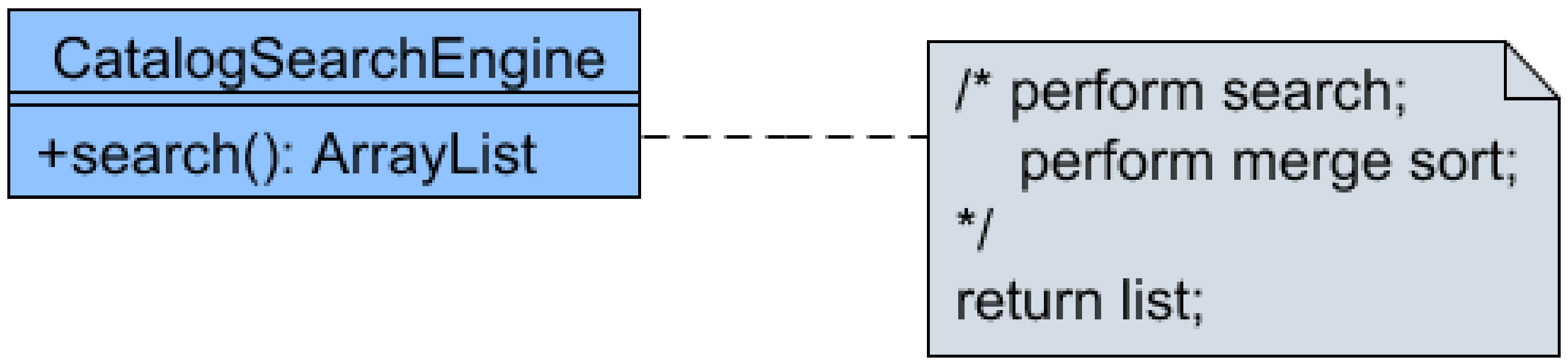
- The client is decoupled from the subsystem components.
- The client does not have to know the underlying process.
- There are fewer network trips in a distributed environment.
- Clients can still communicate directly with the subsystems.

Disadvantage:

- A layer of indirection obscures the underlying process.

Applying the Strategy Pattern: Example Problem

- A library system's `search` method wants to use multiple algorithms for sort results.
- Replacing or adding algorithms requires code modification.



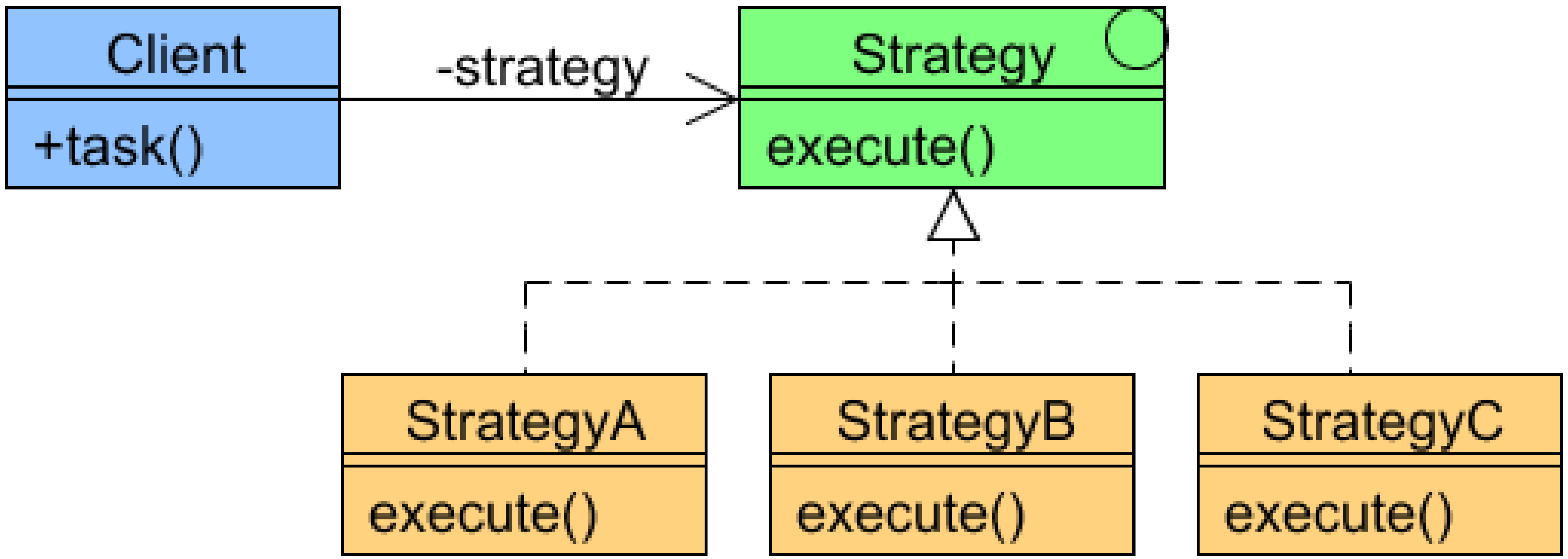
Applying the Strategy Pattern: Problem Forces

- Classes often need to choose from multiple algorithms.
- The details of these algorithms should be hidden from client classes.
- Separating choices by conditional logic is hard to maintain.

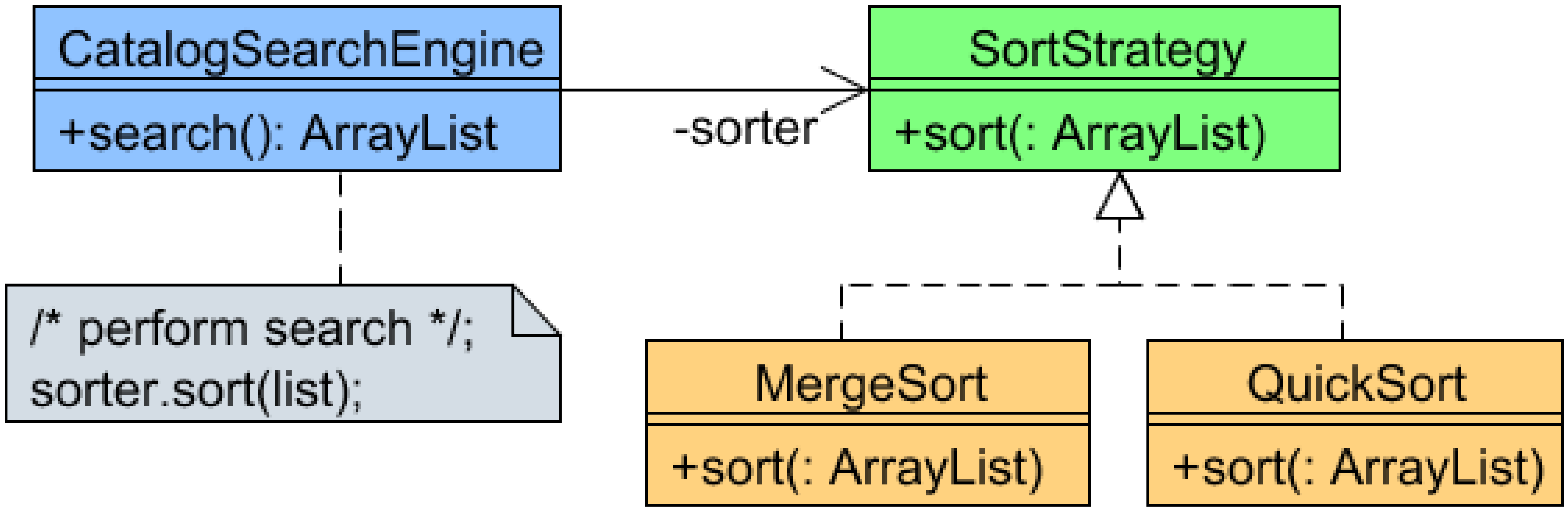
Applying the Strategy Pattern: Solution

- Each algorithm is implemented in a separate class that implements the `Strategy` interface.
- The `Client` object:
  - References a `Strategy` object
  - Delegates the request to the reference
  - May specify the `Strategy` subtype to use (optional)

Applying the Strategy Pattern: Structure



Applying the Strategy Pattern: Example Solution



Applying the Strategy Pattern: Client Code

```java
public class CatalogSearchEngine {

  private SortStrategy sorter;

  public CatalogSearchEngine(SortStrategy ss) {
     sorter = ss;
   }
  public ArrayList search() {
     ArrayList list = //perform search
     sorter.sort(list);
     return list;
   }
 }
```

Applying the Strategy Pattern: Implementing the Interface

```java
public interface SortStrategy {
 public void sort(ArrayList al);
}
```

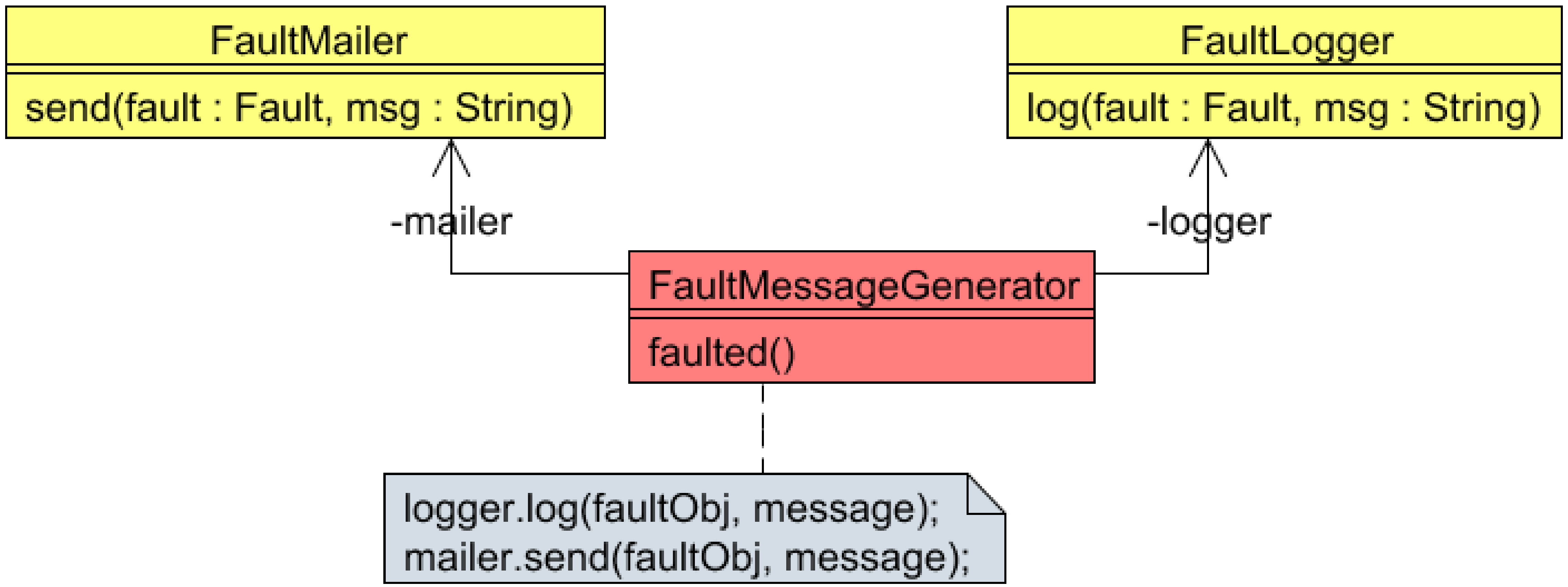
```java
public class QuickSort implements SortStrategy {
   public void sort(ArrayList al) {
//implement Quick sort code
   }
}
```

Applying the Strategy Pattern: Consequences

- Advantages:
  - Adding new strategies does affect the existing code.
  - Branch logic that can grow over time can be avoided.
  - Each algorithm is expressed separately.
  - Change to one algorithm is isolated from other algorithms.
- Disadvantages:
  - Clients must know which strategies are available.
  - Naive clients may expect default logic.
    - A `Strategy` interface can instead be a parent class with a default implementation.

Applying the Observer Pattern: Example Problem

- The `faulted()` method delegates a message to services that are coupled to the `FaultMessageGenerator` class.
- Other fault handlers may be needed.



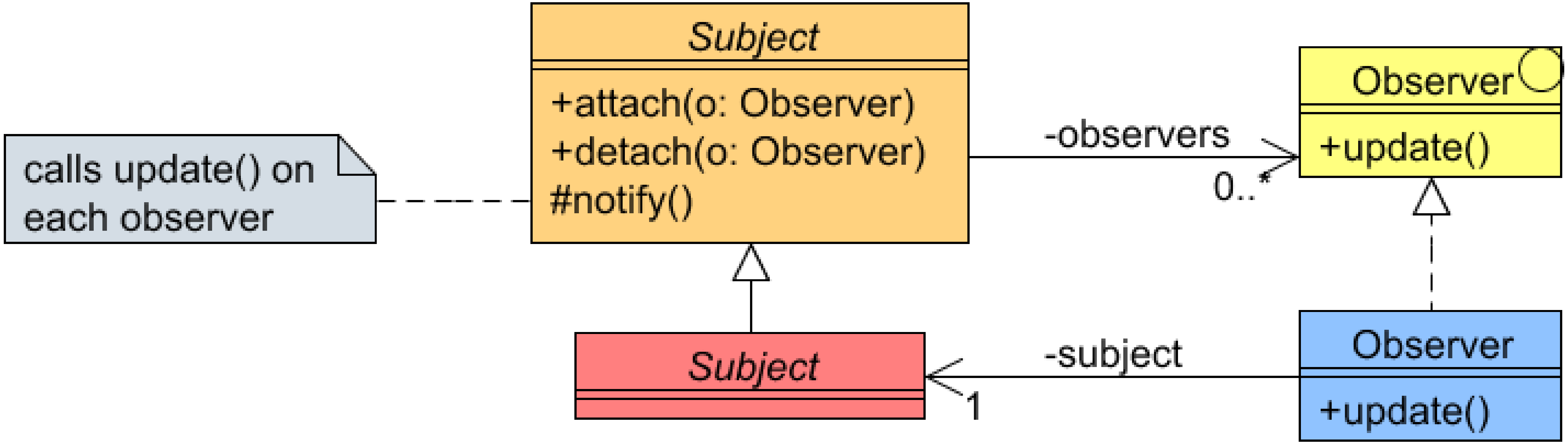
Applying the Observer Pattern: Problem Forces

- Several classes want to monitor changes in another class:
  - Synchronous polling for asynchronous state changes may waste resources.
  - Multiple observers polling an observable object may also require synchronization controls.
  - Observers must know how to get to an observable object.
  - You want to add observers as needed.

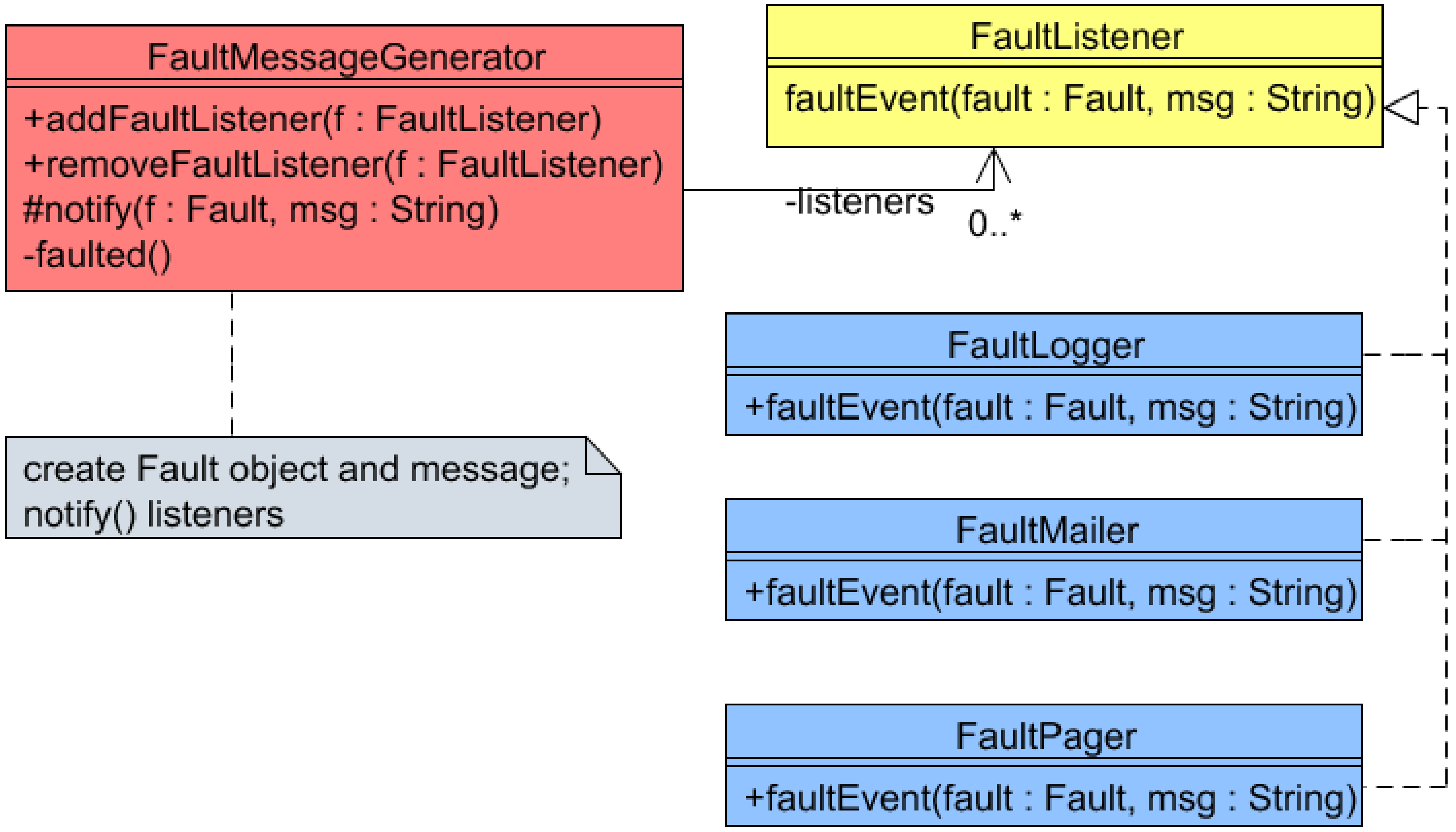
Applying the Observer Pattern: Solution

- Use an Observer interface that lets an observable `Subject` call on `Observer` implementations.
- `Subject` keeps a collection of objects that implement `Observer`.
- The `Observer` objects register with `Subject`.
- The `Subject` notifies the registered `Observer` objects when it changes state.

Applying the Observer Pattern: Structure



Applying the Observer Pattern: Example Solution



Applying the Observer Pattern: Observable Code

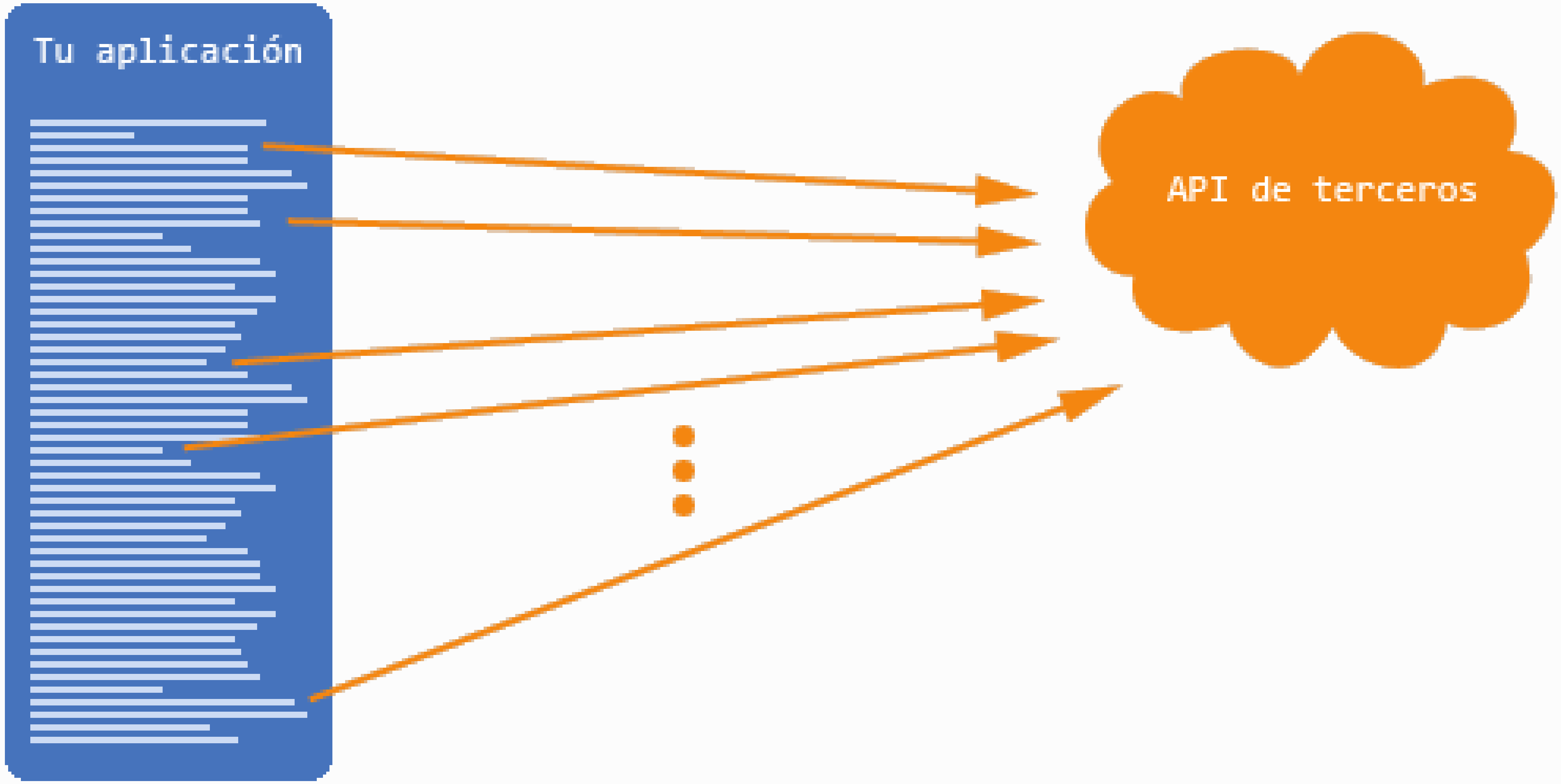
```
import java.util.*;
public class FaultMessageGenerator {
 private ArrayList<FaultListener> listeners =
  new ArrayList<FaultListener>();

 public void addFaultListener(FaultListener listener) {
  listeners.add(listener);
 }
 protected void notify() {
  for (FaultListener fl: listeners) {
    fl.faultEvent(faultObj, faultMsg);
  }
 public void removeFaultListener(FaultListener listener) {
  listeners.remove(listener);
 }
}
```

Applying the Observer Pattern: Observer Code

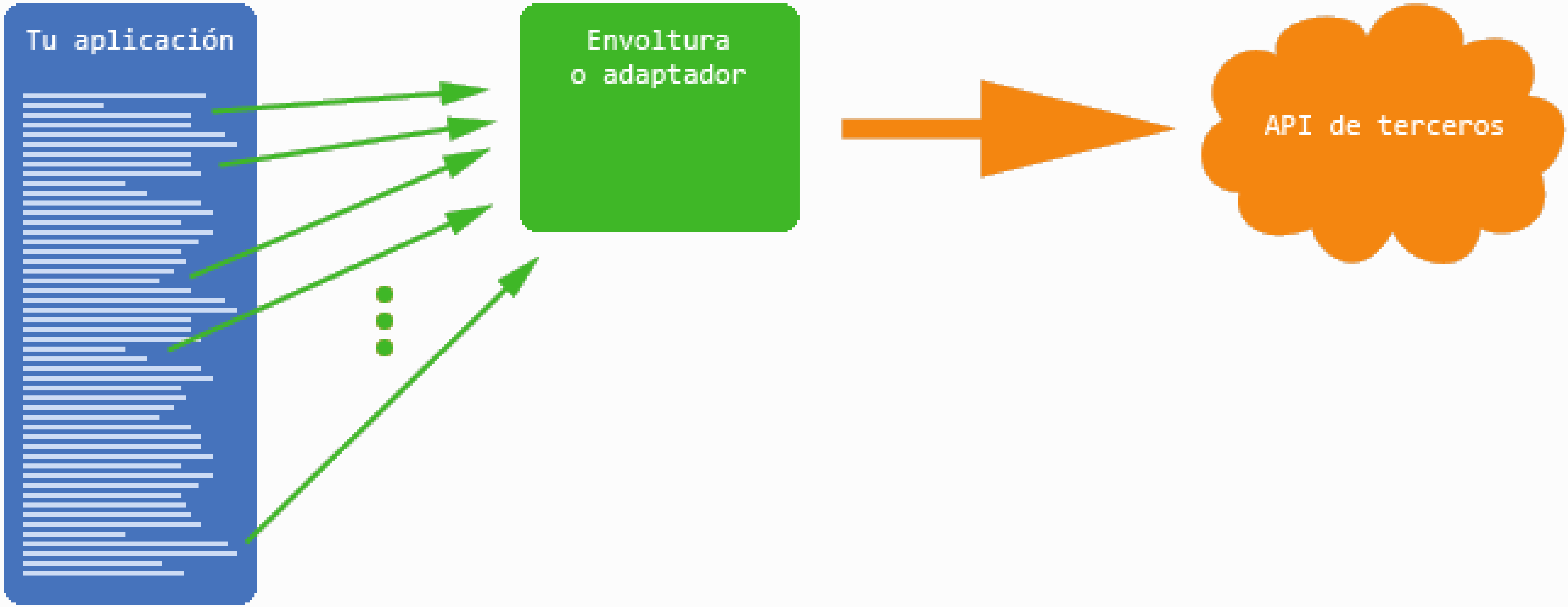
```
import java.util.logging.*;

public class FaultLogger implements FaultListener{
  private static Logger logger =
Logger.getLogger("");

  public FaultLogger(FaultMessageGenerator fmg) {
    fmg.addFaultListener(this);
  }
  public void faultEvent(Fault fault, String msg) {
   logger.log(Level.WARNING,
     "A " + fault.getType() + " occurred: " + msg);
  }
}
```

2. Design Patterns applied to Microservices

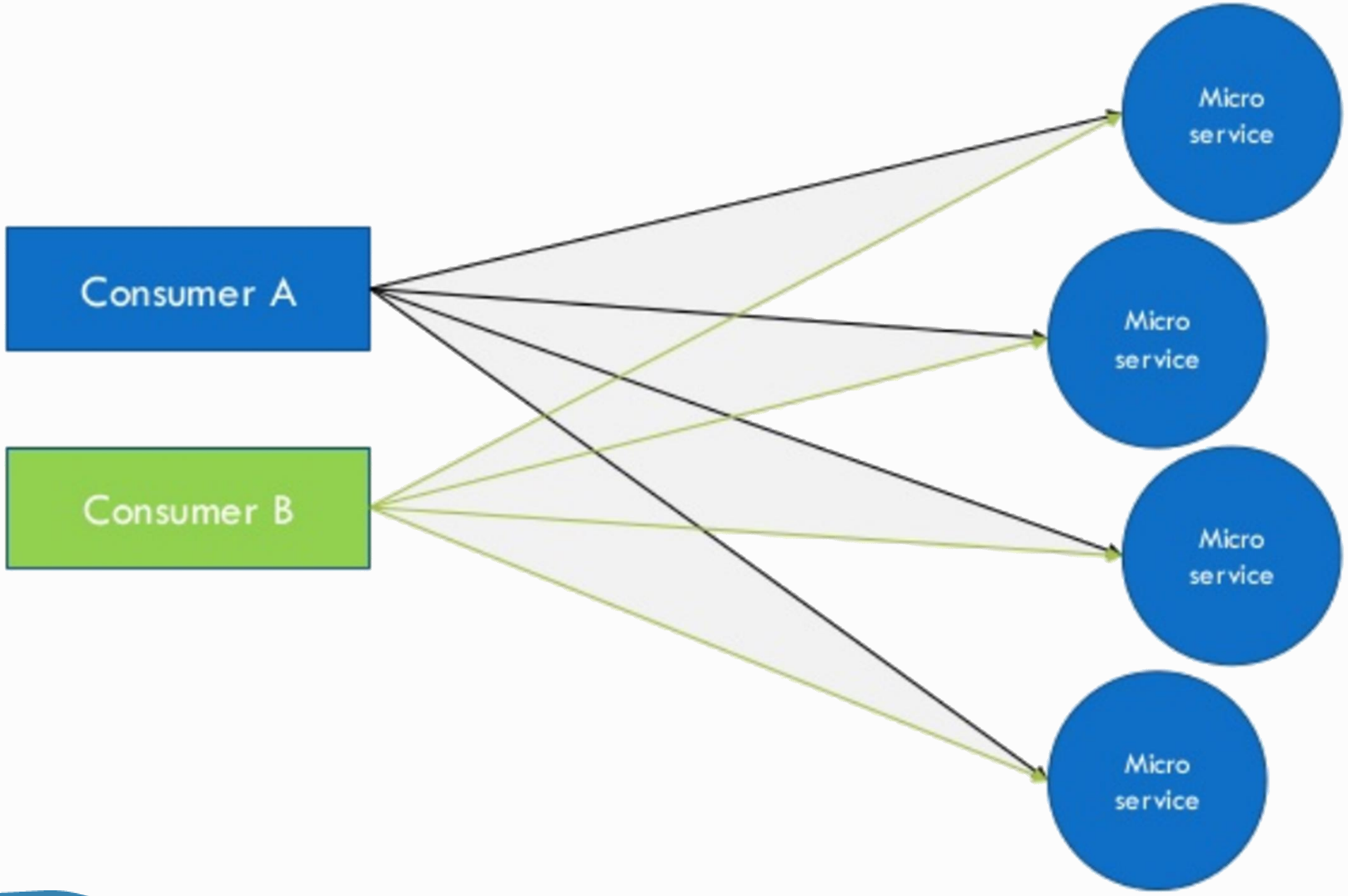
Adapter



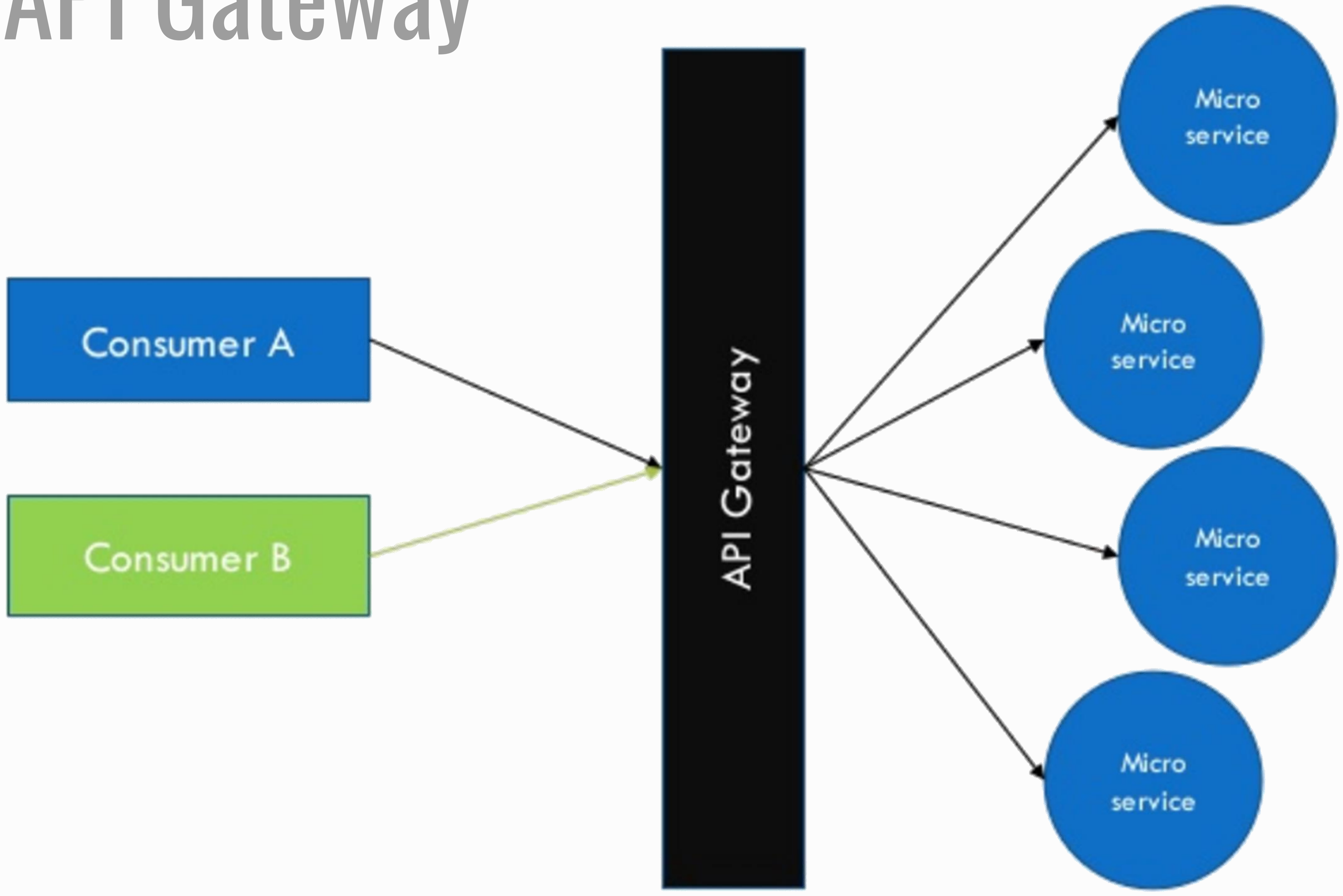
Adapter



Direct Communication



API Gateway



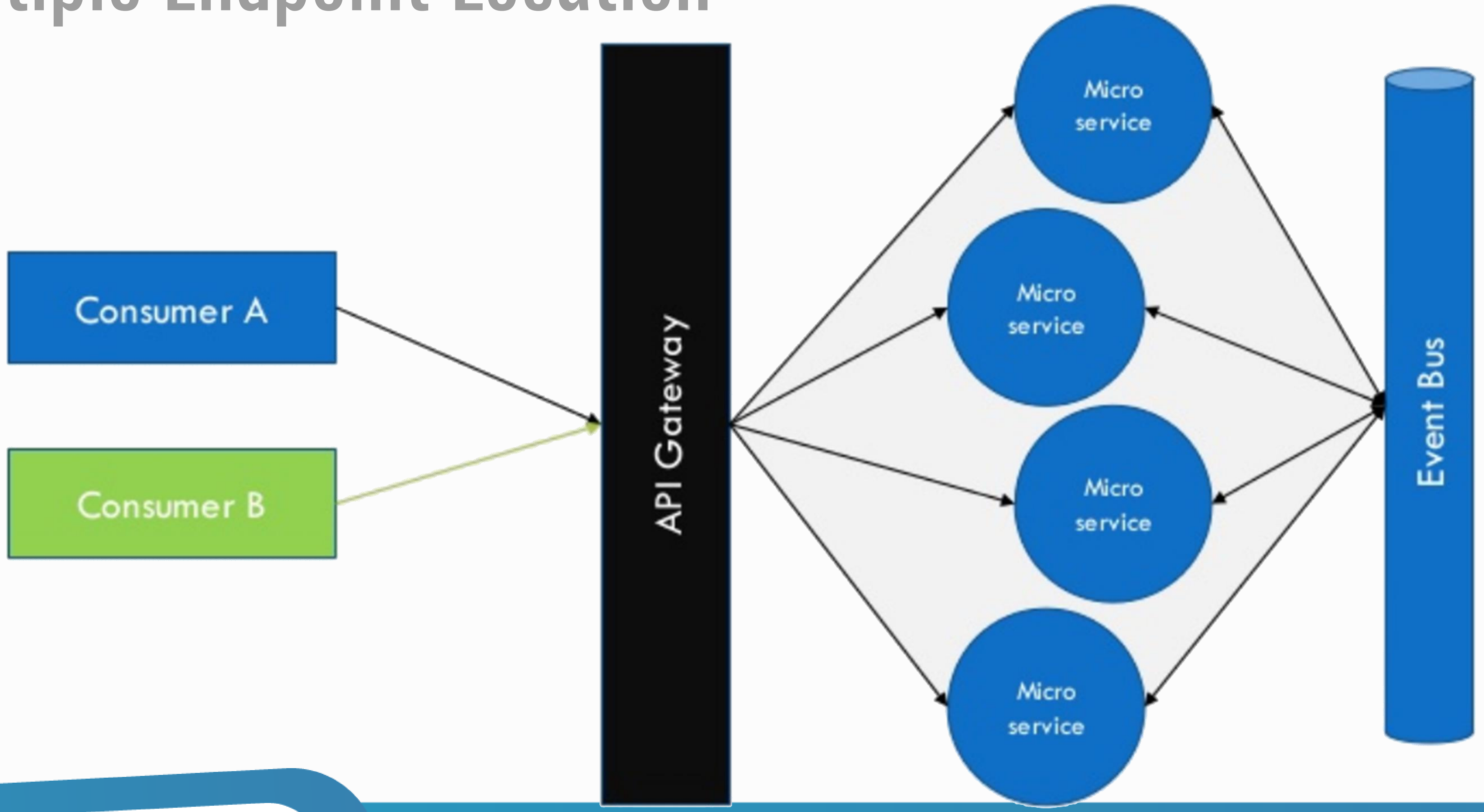
Who is consuming our services?

Who was consuming what?

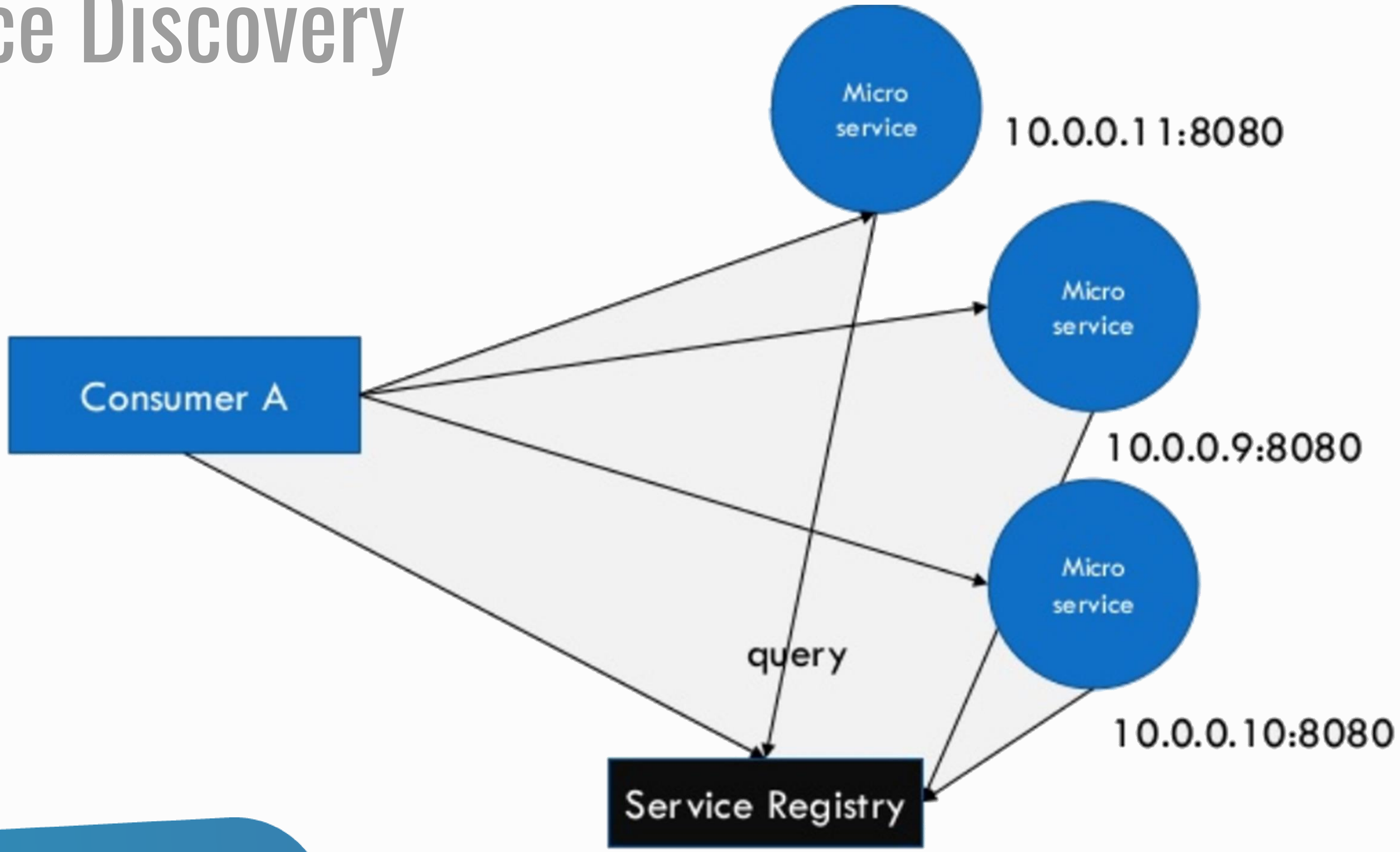
What rate?

What time?

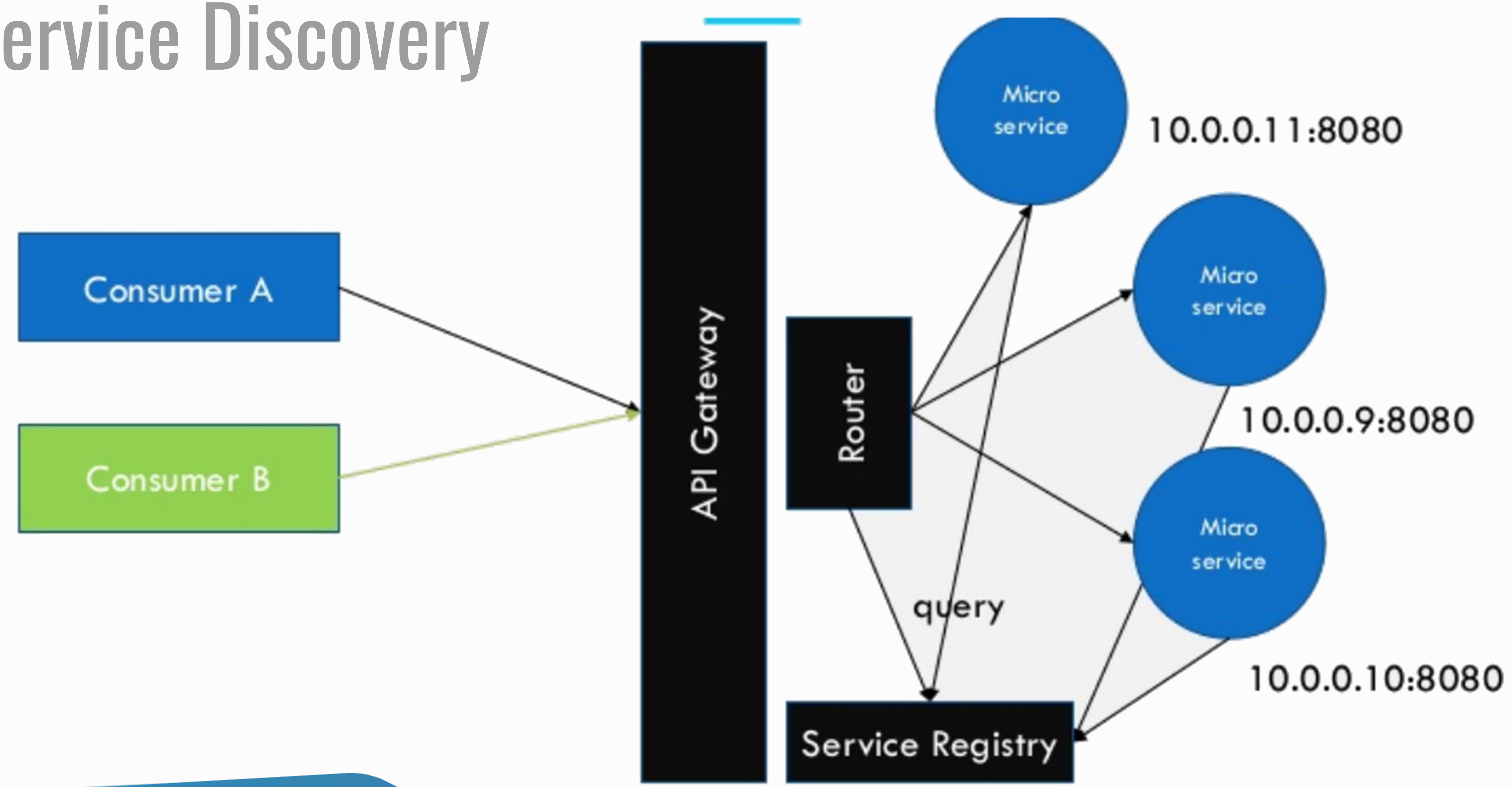
Multiple Endpoint Location



Service Discovery

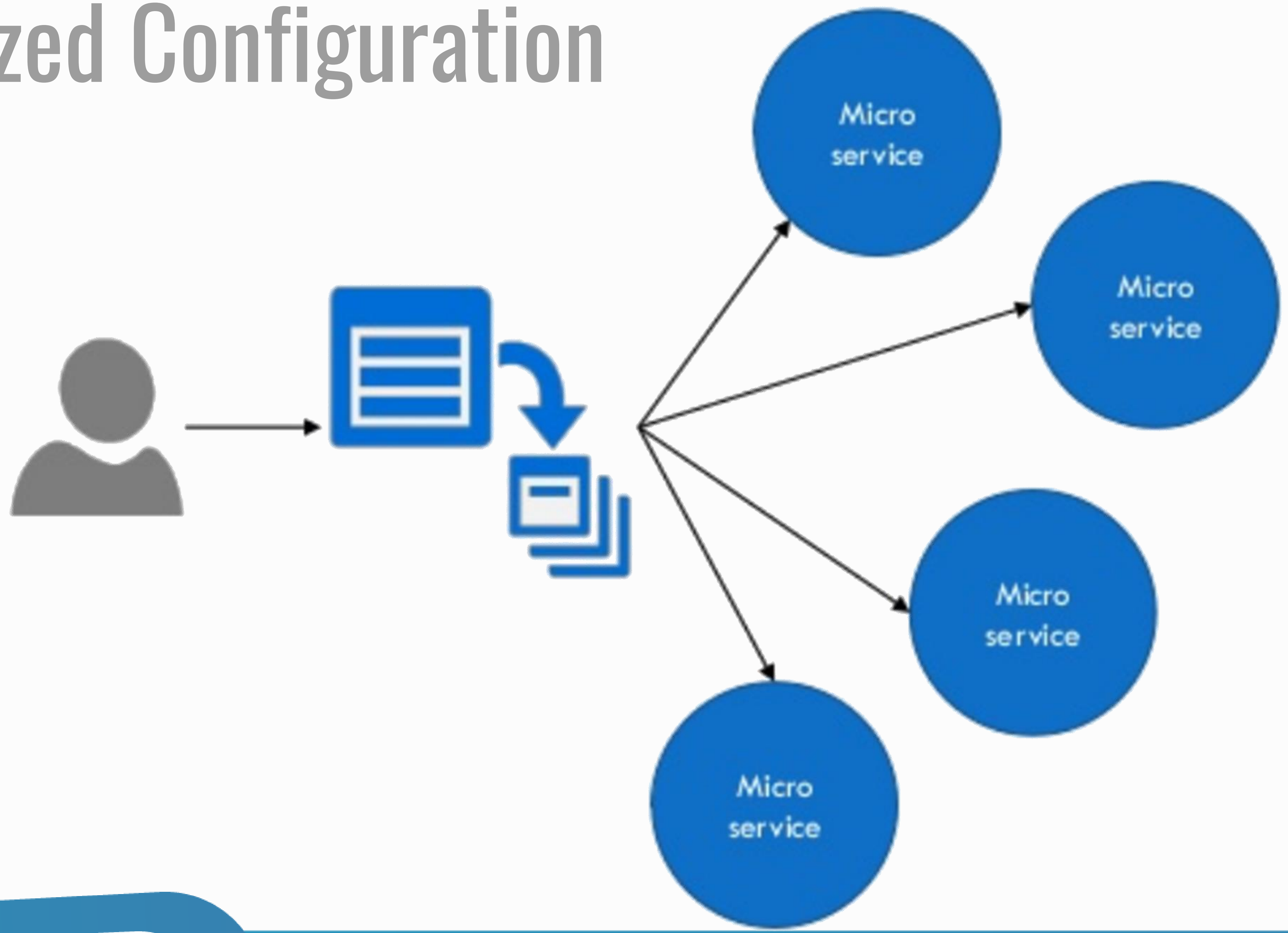


Service Discovery

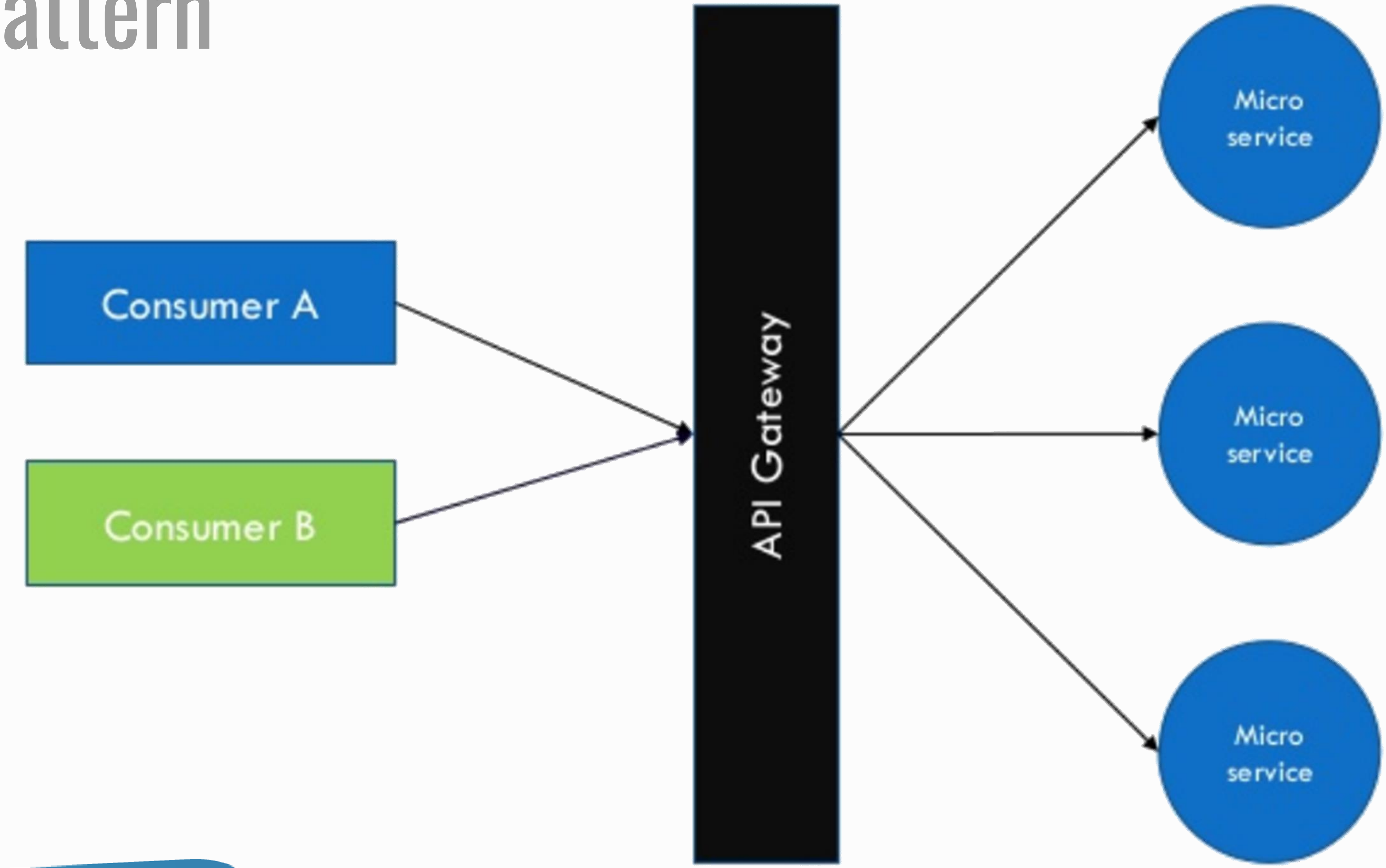


Multiple Configurations

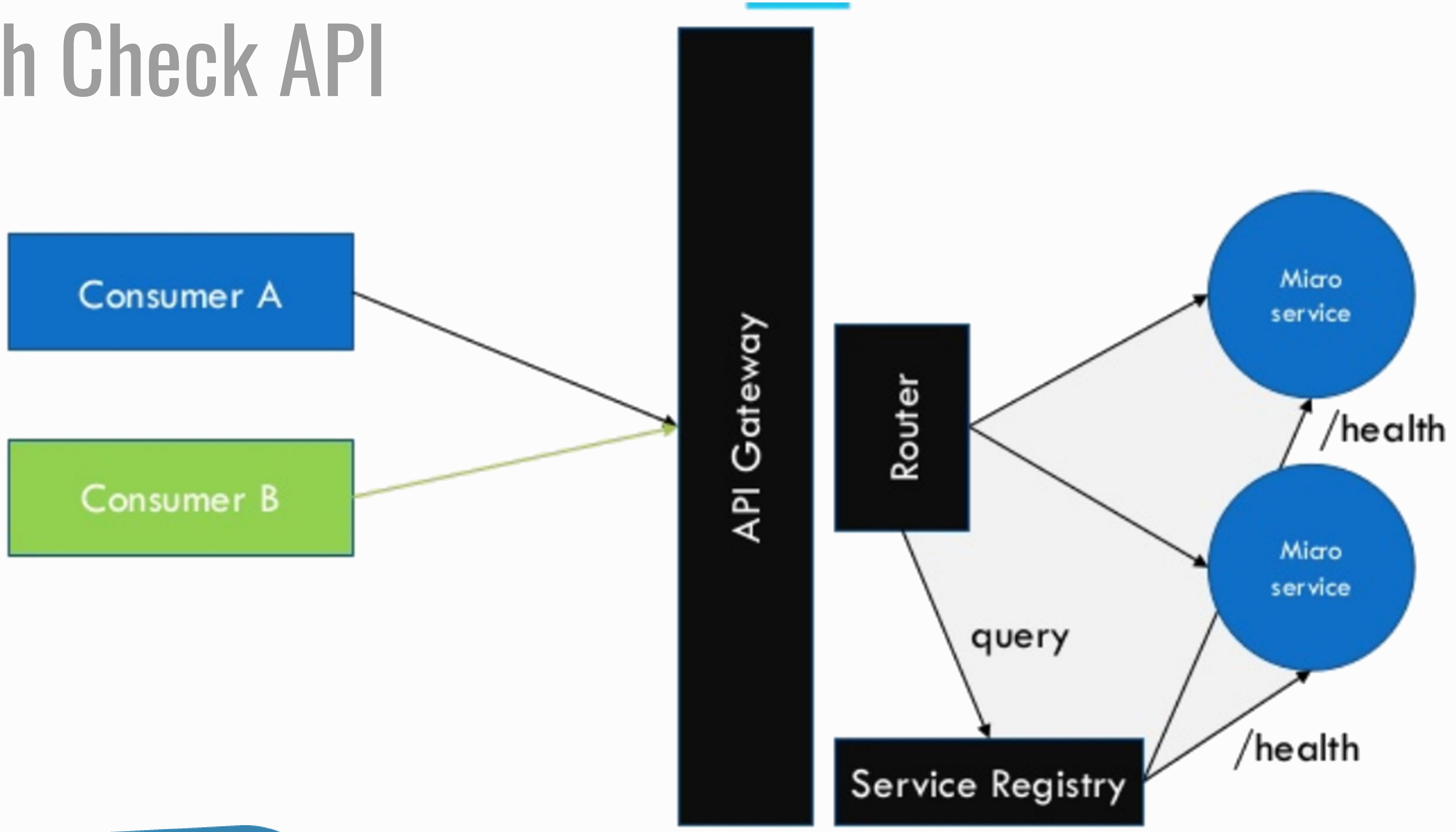
Centralized Configuration



Retry Pattern



Health Check API

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